

Empirical Study on Digital Economy Enabling High-Quality Development of Manufacturing Industry under the New Development Pattern

Laixin Wu

Anhui University of Finance and Economics, College of Management Science and Engineering, China

ABSTRACT

The development of digital economy is leading a profound change in factor allocation and production mode, opening up a favorable time for China's manufacturing industry to move towards the road of high-quality development. Based on the panel data of the province of China from 2000 to 2024, we analyze how the digital economy empowers the actual effect of high-quality development of the manufacturing industry based on the accurate assessment of the digital economy and the level of high-quality development of the manufacturing industry. The results show that the digital economy and the level of high-quality development of the manufacturing industry have shown significant growth over time, however, this growth is significantly uneven across different regions. The digital economy is significantly driving higher quality in manufacturing. In summary, the digital economy is not only a powerful driver of high-quality development of the manufacturing industry, but its impact also crosses geographical boundaries, revealing the complexity and differences of interregional development.

KEYWORDS

Digital Economy; High-quality Development of the Manufacturing Industry; Empirical Study.

1. INTRODUCTION

China has successfully achieved the ambitious goal of building a moderately prosperous society in all respects, and is now striding forward on a new journey towards becoming a socialist modernized power^[1]. At this new stage of development, realizing the historic leap from catching up to leading requires us to profoundly change the economic growth model, resolutely implement the new development concept, and smoothly transition from the stage of high-speed growth to the stage of high-quality development^[2]. However, the domestic and international environments are experiencing profound and complex changes: the global economy continues to weaken, trade protectionism is surging, and epidemic prevention and control have become the norm; domestically, we are facing profound demographic adjustments, arduous tasks of green transformation, and challenges of high-quality development. Against this background, it is particularly urgent and important to grasp the historical opportunity of the new round of scientific and technological revolution and industrial change, and accelerate the construction of a new development pattern with the domestic macro-cycle as the main body and the domestic and international double-cycle promoting each other^[3].

The importance of the real economy, especially the manufacturing industry, as the cornerstone of social survival and development, is self-evident. However, at present, some of China's traditional manufacturing industries are still facing bottlenecks such as lack of innovation ability, weak core competitiveness, and low industrial level, which seriously restricts the realization of the strategic

goals of “Strong Manufacturing Country” and “Strong Quality Country”^[4]. Fortunately, the vigorous development of new-generation information technology such as the Internet, big data, artificial intelligence, 5G, and the rise of the digital economy have opened up new paths for the high-quality development of the manufacturing industry, and strongly promoted the transformation and upgrading of the manufacturing industry in the direction of high-end, intelligent, green, and service-oriented^[5].

Nowadays, the digital economy is gradually reshaping the competitive pattern of the manufacturing industry, providing a crucial turning point for breaking the predicament of China's manufacturing industry, which has been hovering at the middle and low ends of the value chain for a long time, as well as promoting its transformation and deepening development towards high-end^[6]. As the core driving force of the new quality productivity, digital economy not only provides cutting-edge innovation service support for the manufacturing industry and broad application scenarios of new industrialization, but also breeds the core elements and basic power of the new quality productivity, accelerating the cultivation and shaping of the new quality productivity. In view of this, in-depth investigation of the theoretical mechanism of how the digital economy empowers the high-quality development of the manufacturing industry, and verified through empirical tests, has far-reaching strategic significance for the scientific planning of the development policy of the digital economy, and stimulates the potential of high-quality development of China's manufacturing industry^[7].

2. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

As an emerging economic form, the digital economy, with digital infrastructure as its core support, covers all kinds of economic activities relying on digital technologies, services and data elements, which are aimed at enhancing efficiency. The digital economy is driving the manufacturing industry to realize profound changes in multiple dimensions, such as product quality, industrial structure, ecological environment and economic benefits, and injecting new momentum into the high-quality development of the manufacturing industry.

The digital economy has a far-reaching impact on the high-quality development of the manufacturing industry through three direct mechanisms: penetration effect, synergy effect and interaction effect. First, digital technology has widely penetrated into the design, R&D, production and other aspects of the manufacturing industry in the Yangtze River Economic Belt, enabling enterprises to capture user data in real time with the help of digital information technology, and to deeply explore user needs, so as to continuously innovate and optimize the production process, and to cut down on “non-value-added” costs. This not only helps enterprises respond quickly to market changes, but also significantly improves labor productivity.

Secondly, the digital economy realizes the rational and effective allocation of resources by efficiently coordinating the work of various departments within the enterprise. Digital information technology, typified by cloud computing, can accurately capture real-time changes in customer demand, effectively alleviate the problem of information asymmetry, and prompt enterprises to develop products in a short period of time that closely follow market trends.

Furthermore, the digital economy promotes the cyclic interaction of enterprise design, R&D, production and other links. The production department will give timely feedback on the effect of each application of the digital economy, promoting the R & D and design departments to upgrade the existing technology and improve its application principles. The adoption of new digital technologies can further promote the continuous optimization of enterprise production processes, accelerate the construction of digital infrastructure, enhance the level of intelligent manufacturing, and ultimately drive the high-quality development of the manufacturing industry. Based on the above analysis, we put forward the following hypotheses:

Hypothesis 1: The digital economy has a significant role in promoting the high-quality development of the manufacturing industry in the Yangtze River Economic Belt.

3. RESEARCH DESIGN

3.1. Variable Selection and Data Source

3.1.1. Explanatory Variables

Manufacturing high-quality development (MDH) is a comprehensive concept, which requires continuous improvement of product quality to meet the growing demands of consumers, continuous optimization of industrial structure to enhance the competitiveness of China's manufacturing industry in the global market, maintaining the economic efficiency at a high level to ensure the sustained growth of per capita value-added, and creating a clean and efficient production process to achieve win-win situation in terms of economic and environmental benefits. Based on the profound connotation of high-quality development of the manufacturing industry, combined with the theoretical discussions in the previous section and with reference to the research results of Liu Xinxin et al^[8] and Qu Li et al^[9], we constructed an indicator system covering four key dimensions: product quality, industrial structure, ecological environment, and economic efficiency. The specific indicator selection of this system and its detailed description are shown in Table 1. On this basis, we scientifically and objectively calculated the MDH index using the entropy method to quantitatively assess the degree of high-quality development of the manufacturing industry.

3.1.2. Explanatory Variables

Digital Economy (DE). The development of digital economy relies on the increasing improvement of digital infrastructure, the digital industry scale continues to grow, and the degree of digital integration gradually deepens. Therefore, with reference to established research, this paper focuses on the representative areas of digital economy from the three dimensions of digital infrastructure, digital industrialization and industrial digitization, and constructs the indicator system, with the specific indicators selected as shown in Table 2. Accordingly, the DE index is measured by the entropy method.

3.1.3. Description of Control Variables

This paper carefully selects the following control variables to deeply analyze their potential impact on the high-quality development of the manufacturing industry: urbanization rate (UR), government support (GS), consumption level (CL) and openness to the world (OW).

Urbanization and industrialization are closely linked, and a high level of urbanization can promote the orderly transfer of labor resources to the processing and manufacturing sector, thereby increasing the labor productivity of this sector. In order to quantify the urbanization rate, this paper adopts the ratio of urban population to the total population at the end of the year as a measurement indicator.

The high-quality development of the manufacturing industry cannot be separated from the support of a high-quality institutional environment and the effective investment of government funds. For this reason, this paper adopts the ratio of general budget expenditure to gross domestic product (GDP) to characterize the strength of government support to reflect the government's investment in promoting the high-quality development of the manufacturing industry.

The improvement of residents' consumption level and level has a significant role in guiding the manufacturing industry to optimize the supply structure and improve the quality of products and services. In this paper, the ratio of total retail sales of consumer goods to GDP is used to characterize the level of consumption, in order to measure the impact of residents' consumption capacity on the high-quality development of the manufacturing industry.

The introduction of foreign capital not only brings valuable capital flow to the region, but also brings advanced management experience, technological innovation and broad market opportunities, which has a far-reaching impact on the high-quality development of the regional manufacturing industry. In order to quantify the degree of opening up to the outside world, this paper adopts the proportion of

the number of foreign, Hong Kong, Macao and Taiwan invested industrial enterprises to the number of industrial enterprises above the scale as a measurement indicator.

3.1.4. Data Sources

Due to the lack of data on Tibet, Hong Kong, Macao and Taiwan, this paper only selects 30 provinces in China from 2010 to 2021 as the research sample. The reason for choosing provincial-level data is that it is more complete, which is conducive to comprehensively analyzing the trends and patterns of high-quality development of manufacturing industries empowered by the digital economy in each region, and identifying regional development differences through horizontal comparison. The data in this paper mainly come from China Statistical Yearbook, China Industrial Statistical Yearbook, Wind database, etc. Individual missing data are made up by linear interpolation.

3.2. Model Setting

Based on the above theoretical analysis, in order to test hypothesis 1, this paper utilizes panel data to construct the following benchmark regression model:

$$MDH_{it} = \beta_0 + \beta_1 DE_{it} + \sum_{j=2}^n \beta_j X_{j,it} + \varepsilon_{it}$$

Where i denotes province and t denotes time; β_1 is the regression coefficient of digital economy, reflecting the effect of digital economy on the high-quality development of manufacturing industry. β_2 are urbanization rate, government support, consumption level, opening up to the world, etc., ε_{it} is a random disturbance term.

4. RESULTS

4.1. Examination of the Direct Effect of the Digital Economy Empowering the High-quality Development of the Manufacturing Industry

Through Hausman test, this paper selects an appropriate model for regression analysis. The test results show that the fixed effect model (FE) has significant advantages over the random effect model (RE). Given the possible individual and time trend effects of the digital economy and high-quality development of the manufacturing industry in different provincial areas and years, in order to reduce the impact of unobservable factors on the research results, this paper adopts the individual and time two-way fixed-effects model for empirical testing. In addition, in order to effectively deal with the problems of autocorrelation and heteroskedasticity, this paper adopts the robust standard errors adjusted based on clustering at the provincial level to further improve the accuracy of the regression model.

The results of the benchmark regressions are shown in Table 4. Model A1 includes only the digital economy (DE) as an explanatory variable, while the other models gradually introduce the corresponding control variables. By comparing the five models, we can find that the regression coefficient of digital economy is always significantly positive, which is in line with the theoretical expectation, and the core conclusion remains stable after controlling other variables.

Specifically, the estimated coefficient of digital economy in model A5 is 0.3562, and it is significant at 1% significance level, which indicates that the deep integration of digital economy and manufacturing industry has a positive impact on improving the resource allocation efficiency, R&D efficiency and management efficiency of manufacturing industry, and it has become a new engine to promote the high-quality development of the manufacturing industry, which verifies hypothesis 1.

Among the control variables, the coefficients of urbanization rate, consumption level and opening up to the outside world are all significantly positive. This indicates that big cities have resource advantages that help attract factors such as labor and technology, providing a good basic environment for the development of the manufacturing industry. The increase in consumption level prompts manufacturing enterprises to improve product quality and realize higher level of supply. Manufacturing enterprises enhance their competitiveness by attracting capital investment and introducing advanced technology, all of which are significantly favorable to the high-quality development of the manufacturing industry.

However, the regression coefficient of government support is significantly negative. This may be due to the fact that the proportion of general budget expenditure to GDP has gradually declined, while the level of manufacturing development has shown a rising trend year by year. This indicates that the development of the manufacturing industry is increasingly adapting to the market-oriented mechanism, and the dependence on government financial support is reduced. In order to promote the high-quality development of the manufacturing industry, the decisive role of the market in resource allocation should be given full play.

Table 1. Results of the direct effects test

	Model A1 MDH	Model A2 MDH	Model A3 MDH	Model A4 MDH	Model A5 MDH
DE	0.2455*** (0.0405)	0.3562*** (0.0845)	0.3718*** (0.0811)	0.3261*** (0.0798)	0.3562*** (0.08455)
UR		0.7132*** (0.0121)	0.7344*** (0.0012)	0.5562*** (0.0455)	0.3562*** (0.08455)
GS			-0.2562*** (0.0213)	-0.2264*** (0.0845)	-0.2347*** (0.0333)
CL				0.1178*** (0.0349)	0.1573*** (0.0120)
OW					0.4232*** (0.0098)
CONS	0.2755*** (0.0048)	-0.1286 (0.1433)	-0.0235 (0.2344)	-0.0877 (0.2117)	-0.0797 (0.4055)
R ²	0.8301	0.8512	0.8676	0.8712	0.8902

5. CONCLUSION

This paper discusses in depth the influence mechanism of digital economy on the high-quality development of manufacturing industry, and verifies the relevant theoretical assumptions through empirical analysis. The results of the study show that the digital economy has become a key new driving force to promote the high-quality development of the manufacturing industry.

First of all, by constructing the index system of high-quality development of manufacturing industry with four dimensions, including product quality, industrial structure, ecological environment and economic benefits, and measuring the MDH index by entropy value method, we can quantitatively assess the degree of high-quality development of manufacturing industry. This indicator system not

only comprehensively reflects the connotation of high-quality development of manufacturing industry, but also provides a solid foundation for subsequent empirical analysis.

Second, in the empirical analysis, this paper adopts the individual and time two-way fixed effect model, and takes into account autocorrelation, heteroskedasticity and other issues, and uses robust standard errors adjusted based on clustering at the provincial level in order to improve the accuracy of the regression model. The results show that the regression coefficients of the digital economy are all significantly positive, in line with theoretical expectations. In particular, in Model A5, the estimated coefficient of the digital economy is 0.3562 and passes the test at the 1% significance level, further confirming the positive role of the digital economy in promoting the high-quality development of the manufacturing industry.

In addition, the study also found that control variables such as urbanization rate, consumption level and opening up to the outside world also have a significant positive impact on the high-quality development of the manufacturing industry. This indicates that large cities are more conducive to the aggregation of labor, technology and other factors due to their resource advantages; the increase in consumption level can guide manufacturing enterprises to improve product quality; and opening up to the outside world can bring external resources such as capital, technology and management experience, which are all conducive to the high-quality development of the manufacturing industry.

However, it is worth noting that the regression coefficient of government support is significantly negative. This may be due to the fact that with the increasing perfection of the market-oriented mechanism, the dependence of manufacturing development on government financial support is gradually weakening. Therefore, in order to promote the high-quality development of the manufacturing industry, the decisive role of the market in resource allocation should be given full play to, while focusing on optimizing the government's support methods and improving the efficiency of capital use.

In summary, the research in this paper not only enriches the theoretical system of digital economy and high-quality development of manufacturing industry, but also provides useful reference for the formulation of relevant policies. In the future, it should continue to deepen the integration of digital economy and manufacturing industry, and promote the development of manufacturing industry in the direction of high-end, intelligent and green, in order to achieve higher quality development.

ACKNOWLEDGEMENTS

This project is a national college student innovation training program of Anhui University of Finance and Economics (202310378255).

REFERENCES

- [1] Gao Lili, Lu Changyun, Zhu Jiaming. An empirical study of digital economy empowering high-quality development of manufacturing industry under the new development pattern--Taking the Yangtze River Economic Belt as an example[J]. Journal of Natural Sciences of Harbin Normal University, 2023, 39(04): 21-32.
- [2] Beomsoo Kim, Barua Anitesh, Whinston Andrew-B. Virtual field experiments for a digital economy: a new research methodology for exploring an information economy[J]. Decision Support Systems, 2002, 32(3): 215-231.
- [3] Pekka Räsänen, Koivula Aki, Keipi Teo. Online information seeking patterns and social inequality in a digital economy[J]. The International Review of Retail, Distribution and Consumer Research, 2021, 31(2): 211-228.
- [4] Zhang Yuche. Development Ideas and Main Tasks of Digital Economy Driving Industrial Structure Toward Middle and High-end[J]. Economy Vertical, 2018, (09): 85-91.
- [5] Zuo Pengfei, Chen Jing. Digital economy and economic growth under the perspective of high-quality development[J]. Research on Financial Issues, 2021, (09): 19-27.
- [6] Li YJ, Han P. Mechanisms and paths of high-quality development of manufacturing industry under digital economy[J]. Macroeconomic Management, 2021, (05): 36-45.

- [7] LIU Chengkun, LIN Mingyu. A study on the statistical measurement and spatial and temporal evolution characteristics of the level of high-quality development of manufacturing industry[J]. Contemporary Economic Management, 2023, 45(08): 56-68.
- [8] Liu XX, Hui N. Research on the impact of digital economy on the high-quality development of China's manufacturing industry[J]. Economic System Reform, 2021, (05): 92-98.
- [9] QU Li, WANG Lu, JI Huanyong. Analysis on the measurement of high-quality development of regional manufacturing industry in China[J]. Research on Quantitative and Technical Economics, 2021, 38(09): 45-61.